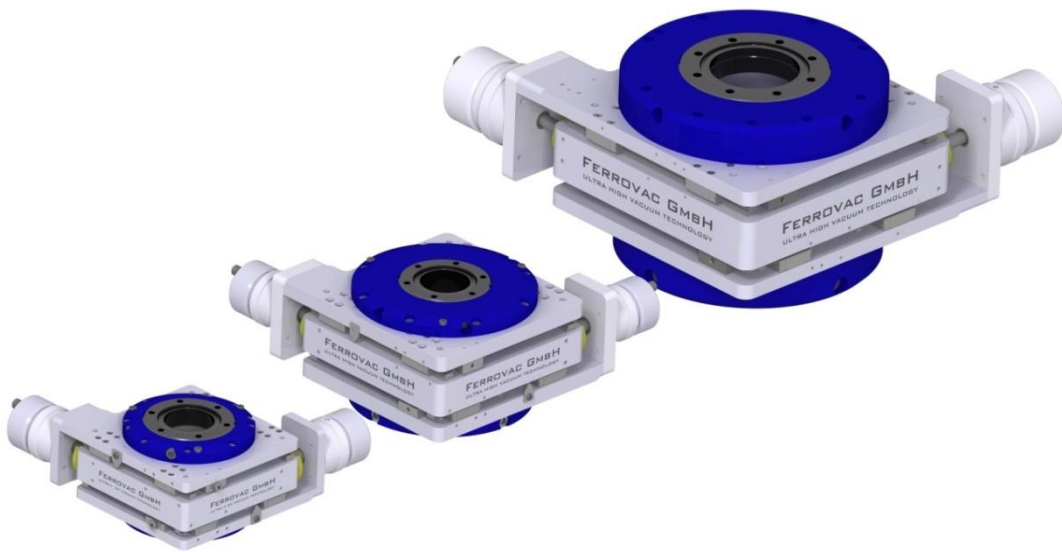


FERROVAC GMBH

ULTRA HIGH VACUUM TECHNOLOGY

Boomerax XY Stage Series



Operating Instructions

Version 1.0 [November, 2019]

Ferrovac GmbH
Thurgauerstrasse 72
CH-8050 Zürich

Phone +41 44 273 16 38

sales@ferrovac.com

www.ferrovac.com



Important!

It is the sole responsibility of all users to carefully read the operating instructions and keep them safe. Read and follow all safety instructions carefully before using the product described in this document. Ferrovac GmbH declines any and all responsibility and liability for any damage/injuries resulting from incorrect use/adjusting/controlling or programming of the product.

Warranty

Ferrovac GmbH warrants this product to be free of defects in material and workmanship for a period of 24 months from the date of shipment. In case of proof of any defective parts in the product, we will at our option, either repair the product or replace it.

Warranty limitations

The warranty for this product does not apply to defects resulting from the following:

- Non-observance of operational- and safety instructions
- Natural wear of components
- Consumables
- Modifications to our products without our written consent
- Misuse of any product or part of the product

This warranty stands in place of all other warranties, implied or expressed, including any implied warranty of implied merchantability or fitness for a particular use. The remedies provided herein are buyer's sole and exclusive remedies.

Neither the company Ferrovac GmbH nor any of its employees shall be liable for any direct, indirect, incidental, consequential or special damages arising out of the use of its products, even if the company Ferrovac GmbH has been advised in advance of the possibility of such damages. Such excluded damages shall include but are not limited to: Costs of removal and installation, losses sustained as the result of injury to any person, or damage to property.

Copyright

Copyright 2019, Ferrovac GmbH. All rights reserved. All information in this document is the sole property of Ferrovac GmbH and is protected by Swiss copyright laws and international conventions. Ferrovac GmbH grants the right for reproduction for the purchasers own use. No part of this manual may be reproduced or transmitted by any third party in any form or by any means and for any purpose without the written permission of Ferrovac GmbH.

1	General Information.....	4
1.1	Designated Use.....	4
2	Terms and Symbols	5
3	General Safety Information.....	5
4	About.....	7
4.1	Dimensions.....	7
4.2	Product Configuration List.....	8
4.3	Specifications.....	9
5	Installation.....	10
5.1	Unpacking and Installation.....	10
6	Operation	11
6.1	Tilt Adjustment.....	11
7	Maintenance.....	12
7.1	Venting and Pumpdown.....	12
7.2	Bakeout.....	12
7.3	Normal Operation after Bakeout	13
8	Options and Upgrades.....	13
8.1	Stepper Motor Kit.....	13
8.2	Limit Switch Kit.....	14
8.2.1	Technical Data for Limit Switch Kit:.....	14
8.2.2	Limit Switch Adjustment	14
8.3	Load Compensation and Load Relief Upgrade	15
8.4	Linear Absolute Optical Encoder Kit for X-Translator.....	15
8.5	Travel Flange Upgrade for MXY Boomerax	15
9	Additional Information.....	16
9.1	Return of Defective Items	16
9.2	Downloads.....	16

1 General Information

This manual covers all important information about installation, commissioning and operation of your Boomerax XY Stage. It also provides important safety information, maintenance- and fault finding procedures.

The product described was manufactured in accordance with the applicable national standards and guidelines. The information in this document represents the state of the product at the date of print. Technical changes may be made without notice. Ferrovac GmbH makes no warranties or representations with respect to accuracy or completeness of the contents of this publication. Figures and photos are not binding. The product names used are for identification purposes and may be trademarks of their respective companies.

1.1 Designated Use

The product described in this document may only be used for its designated application. Designated use of the product is exclusively given if the following rules are obeyed:

- Product is used with original parts supplied by Ferrovac which are explicitly specified for the use with the product described in this publication
- In an indoor research laboratory environment or an industrial production or processing facility
- By personnel qualified for operation of delicate scientific equipment
- In accordance with all related manuals.










Important!

Carefully read all safety instructions and all relevant manuals before using the product and any related equipment!

Non-designated use is given if the following is true:

- Product is used with other equipment not explicitly acknowledged by Ferrovac in writing.
- Product is used outdoors or at ambient conditions exceeding the values given in the product specification
- Product is used by non-qualified persons
- Operation of the product in disregard of the safety instructions
- Operation of the product with disabled, modified, removed or damaged safety equipment and devices.

2 Terms and Symbols

Symbol	Term	Meaning
	Danger!	Risk of mortal danger when not observed
	Warning!	Risk of severe injury or danger to life when not observed
	Caution!	Slight risk of injury or damage to product when not observed
	High voltage!	Potentially lethal voltages are present
	Cryogenic Substances!	Potential cold burn hazard if safety precautions are not followed
	Important!	Important information for proper operation of the product
	Info, hint!	Useful hints, tips and clues

3 General Safety Information

Read the safety instructions very carefully. All safety precautions must be strictly observed at all times before using the product described in this manual and any associated instrumentation.

Study this document to learn how to operate your product properly. Keep this instruction manual in a safe place close to the described product and inform all other users of the product. Always include this manual when handing the product over to third party persons.

Responsible body is the individual or group of persons that are responsible for the proper use and maintenance of the product, ensuring that the product is operated within its specifications and operating limits. The responsible body must ensure that users of the product are adequately trained.

Operators are using the product for its intended purpose. Users must be trained in electrical safety, handling of cryogenic liquids and adequate use of the instrument. They must be protected from electric shock and contact with potentially dangerous situations.

Maintenance Personnel perform routine tasks on the product to keep it in proper operating conditions i.e. setting up the line voltage or replacing consumables. Maintenance procedures are described in this manual and must be followed at all times.

Service Personnel are trained to work on live circuits and to work cryogenic liquids as well as perform fault finding measurements and repair work to the product. Only fully trained service personnel qualified to handle potentially lethal voltages may perform servicing and repair.

Shock hazard: The American National Standards Institute states that a shock hazard exists when voltage levels are greater than 30 V RMS, 42.2 V peak or 60 VDC. A good safety practice is to assume that hazardous voltages are present in any unknown circuitry.



Warning!

- Always observe and strictly follow the safety notes and regulations given in this document
- Never operate the device outside its dedicated environment.
- DO NOT OPEN the device unless you fulfill the requirements of a fully trained service personnel and you are familiar with ultra-high vacuum products



Important! Ambient conditions and environment:

This product is only to be used indoors, in locations meeting the following requirements:

- Room temperature lies between 5°C/41°F and 40°C/104°F
- Humidity up to maximum of 80%
- Altitudes up to 2000m
- Pollution Degree 2 environments

4 About

The Boomerax XY Stage was specifically designed to provide high precision XY manipulation and may be applied in high and ultra-high vacuum assemblies. The Boomerax XY Stage offers exceptionally smooth 2-axis adjustment. Motorized actuation is generally available optionally.

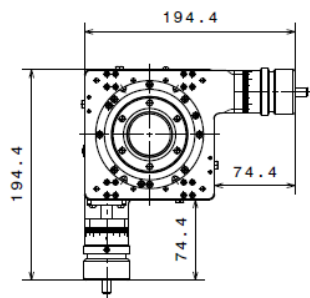
The Boomerax XY Series is available in 3 different nominal sizes (MX40, MXY63 and MXY100). The travel (in-plane) and mounting flange sizes depend on the bore. To provide an overview of the different combination possibilities, please refer to the following technical drawing and product configuration list.

4.1 Dimensions

Technical drawing of the Boomerax Series. All measures are in mm.

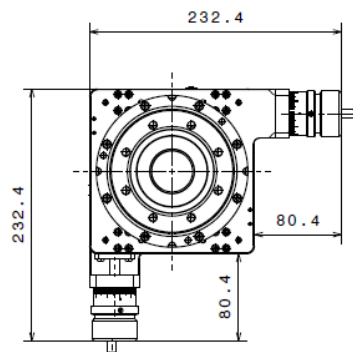
BOOMERAX MXY40:

- Nominal Size: 40
- Max Travel: +-10mm



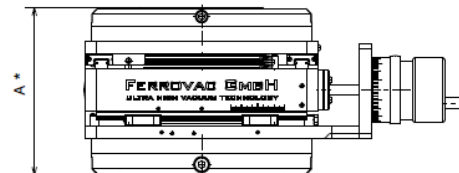
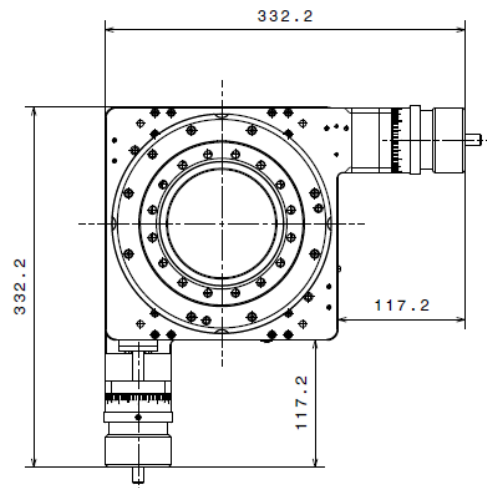
BOOMERAX MXY63:

- Nominal Size: 63
- Max Travel: +-12.5mm



BOOMERAX MXY100:

- Nominal Size: 100
- Max Travel: +-12.5mm or +-25mm



*Dimension A: please refer to 4.2 Product Configuration List

4.2 Product Configuration List

With respect to the 3 different Boomerax nominal sizes, following combinations are possible:

Standard configuration

Base Flange		Travel Flange		Max XY Travel [mm]	Nominal Size	Installation length A [mm]	Product Key	
Size	Tapped	Size	Tapped					
DN40CF (2.75" OD)	✓	DN40CF (2.75" OD)	✓	±10	40	82	MXY40CF40TCF40TXY10	
	✗		✓	±10	40	93	MXY40CF40CF40TXY10	
DN63CF (4.50" OD)	✓	DN40CF (2.75" OD)	✓	±10	40	86.5	MXY40CF63TCF40TXY10	
	✗		✓	±10	40	99.5	MXY40CF63CF40TXY10	
	✓		✓	±12.5	63	101.5	MXY63CF63TCF40TXY12	
	✗		✓	±12.5	63	-	MXY63CF63CF40TXY12	
	✓	DN63CF (2.75" OD)	✓	±12.5	63	105.5	MXY63CF63TCF63TXY12	
	✗		✓	±12.5	63	-	MXY63CF63CF63TXY12	
DN100CF (6.00" OD)	✓	DN40CF (2.75" OD)	✓	±12.5	63	-	MXY63CF100TCF40TXY12	
	✗		✓	±12.5	63	-	MXY63CF100CF40TXY12	
	✓	DN63CF (2.75" OD)	✓	±12.5	63	-	MXY63CF100TCF63TXY12	
	✗		✓	±12.5	63	-	MXY63CF100CF63TXY12	
	✓		✓	±12.5	100	127.5	MXY100CF100TCF63TXY12	
	✗		✓	±12.5	100	-	MXY100CF100CF63TXY12	
	✓		✓	±25	100	155	MXY100CF100TCF63TXY25	
	✗		✓	±25	100	-	MXY100CF100CF63TXY25	
	✓	DN100CF (6.00" OD)	✓	±12.5	100	-	MXY100CF100TCF100TXY12	
	✗		✓	±12.5	100	-	MXY100CF100CF100TXY12	
	✓		✓	±25	100	-	MXY100CF100TCF100TXY25	
	✗		✓	±25	100	-	MXY100CF100CF100TXY25	
DN160CF (8.00" OD)	✓		DN63CF (2.75" OD)	✓	±12.5	100	-	MXY100CF160TCF63TXY12
	✗			✓	±12.5	100	-	MXY100CF160CF63TXY12
	✓	✓		±25	100	155.5	MXY100CF160TCF63TXY25	
	✗	✓		±25	100	-	MXY100CF160CF63TXY25	
	✓	DN100CF (6.00" OD)	✓	±12.5	100	-	MXY100CF160TCF100TXY12	
	✗		✓	±12.5	100	-	MXY100CF160CF100TXY12	
	✓		✓	±25	100	-	MXY100CF160TCF100TXY25	
	✗		✓	±25	100	-	MXY100CF160CF100TXY25	

4.3 Specifications

- Pressure Range: 1E-11 to 1000 mbar
- He Leak Rate: $< 5E-10 \text{ mbar} \times \text{l} \times \text{s}^{-1}$
- Bakeout Temperature: 150 °C (remove motors and encoders!)
- Heating and Colling Rate: $50 \text{ °C} \times \text{h}^{-1}$
- Operating Temperature: Ambient temperature (-10°C to 50°C)
- Adjustable Tilt: $\pm 2^\circ$ in any desired axis
- Travel Resolution: 2 μm (if manually driven)
- Material:
 - Body: EN AW-5754, AISI 304 (1.4301), AISI 316L (1.4435)
 - Bellows: AISI 304 (1.4301)
 - Linear Rails: Stainless Steel, Fluororubber
 - Anodized: EN AW-6060
 - Ball Bearings: Stainless Steel
- Tolerances:
 - Machined Parts: ISO 2768 -m -K
 - Welded Structures: $\pm 1 \text{ mm}$ and $\pm 1^\circ$



Caution!

Specification can change if some upgrades or accessories are mounted to the main product.

5 Installation

Before unpacking, optically inspect the parcel. If damage is found, take pictures of the parcel and send them to Ferrovac GmbH immediately. Package content depends on each specific Boomerax configuration. Compare content with the delivery note. Any damage or missing item must be reported to Ferrovac **within 48 hours after delivery**.



Caution!

- Ensure enough work space on a clean table for unpacking and inspection
- Some products of Ferrovac might be shipped under UHV! Sudden uncontrolled venting cause damage to pumps and valves
- Read manuals carefully before using any device
- Never expose any component of the product/system to physical shock or aggressive chemicals
- Neither hit the CF flange knife edge nor any bellows

5.1 Unpacking and Installation

The Product, its components and accessories are sealed in a cleaned plastic bag. Do not open and remove it until you are ready to mount the assemblies to the system. Prepare the system where you want to mount the stage according to its operations manual. Prepare a very clean, dust-free bench. Carefully unpack the Product and perform a visual check for any damage of the package, its contents and accessories.

As for all UHV type equipment, clean, lint-free gloves should be used for handling the parts exposed to vacuum. All operations should be conducted on the prepared clean dust-free bench. Locate the stage to the system mounting flange using a new, clean CF copper Conflat gasket, pump and bake as necessary. For bakeout, please refer to section 7.2 Bakeout.

6 Operation



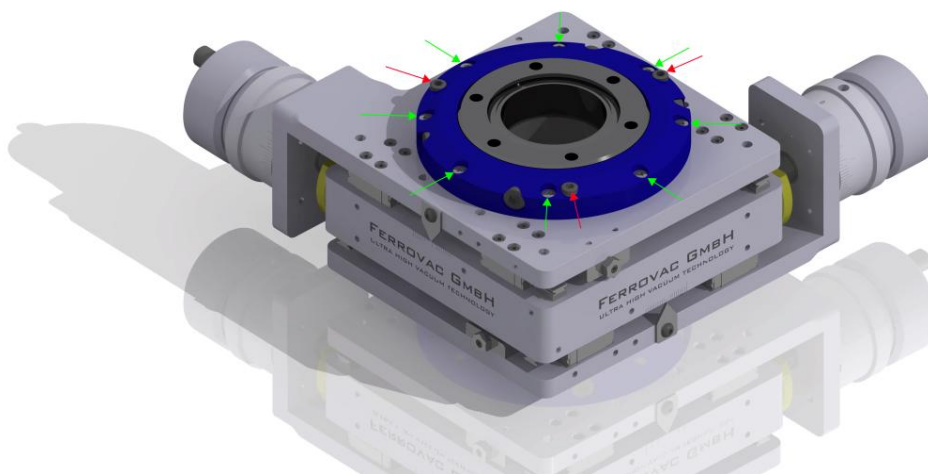
Caution!

It is the responsibility of the operator to continuously and before each use observe the overall technical condition (externally recognizable deficits and damage as well as alterations to the operational behavior) of the system!

The Boomerax XY stage is a rugged component for translating linear motion through a lead-screw applied to a bellows stack. The bellows stack is supported in a precision kinematic guide system, allowing 'X' and 'Y' motion according to its specifications. For X & Y adjustment, the precision micrometer drives can be used, where a precision up to 2 μm can be achieved manually. The motorized and encoded upgrade version can achieve higher resolutions.

6.1 Tilt Adjustment

- Tilt Adjustment Screws
- Counter Lock Screws



A tilt motion is designed as alignment device to allow the travelling flange to be offset with respect to the fixed mounting flange. The tilt can be adjusted by $\pm 2^\circ$ in any desired axis. In order to adjust the tilt, two different screw sets have to be adapted (see figure). First, the counter lock screws (8 in total), have to be loosened, and then the tilt adjustment screws (3 in total) can be set. After, the counter lock screws need to be fastened again. This is completely done outside of UHV; fastening and loosening the described screws will not break the vacuum.

7 Maintenance

7.1 Venting and Pumpdown



Caution!

- If vented through pressurized gas, make sure that the pressure does not exceed 1000 mbar. Overpressure may damage the bellows, viewports or other pressure sensitive components.
- Make sure that all parts of the affecting system are strictly at room temperature before venting!
- CF knife-edges are very sensitive! Avoid using any sharp instrument in the vicinity of the knife-edge. CF flanges must be handled by qualified personnel only!

7.2 Bakeout



Caution!

- Always check the vacuum conditions before and during bake-out. Do not start a bake-out if pressure is higher than 1E-7mbar
- Motors, encoders and other parts which are not specified for your bakeout temperature have to be removed
- The maximum baking temperature of the product may never be exceeded.
- Heating and cooling rate should not exceed 50 °C x h-1
- During bake-out, recheck that the pumping system is running normally and that the vacuum level does not exceed the low 1E-6 mbar range.

After having mounted the Boomerax XY Stage, a chamber bakeout might be carried out. Reaching vacuum levels below approximately 5E-9 mbar requires bakeout at a temperature above 100°C for a sufficiently long time. Such a bakeout should always be carried out along with the chamber bakeout. Since the absorbates have to be removed from the system during bakeout, it is advisable to always pump the volume. Make sure that a pumping system is used that does not automatically vent in case of power failure; the latter could lead to damage of UHV components due to rapid oxidation.

For the bakeout, pump the system down to a pressure lower than <1E-7 mbar. Any motors and encoders, as well as non-bakeable items (i.e. plastic lids, packing material, tools, non-bakeable cables, pressure gauge electronics, flammable substances etc.) always need to be removed from the bakeout zone.

For the bakeout, only use an original Ferrovac heater unit with the correct operating voltage. In case no Ferrovac original isolation jacket and heater is used, install heating and isolation equipment according to you laboratory's standard procedures for baking UHV systems. Ferrovac declines all warranty for damages that may occur due to overheating if third party equipment is used for bakeout. The maximum bakeout temperature of the Boomerax XY Stage is 150°C. During bakeout, the heating and cooling rate should not exceed 50 °C per hour. Recheck that the pumping system is running normally and that the vacuum level during bakeout does not exceed the low 1E-6 mbar range.

7.3 Normal Operation after Bakeout

After bakeout, ensure that the lead-screw is adequately lubricated. The lead-screw requires periodic lubrication a using high temperature, high performance lubricant (e.g. Motorex 3000, **not UHV compatible!**). Apply directly to the screw using a suitable paint brush. If baked frequently, it might be necessary to lubricate the guide rails (e.g. Du Pont KRYTOX GPL225, **not UHV compatible!**).

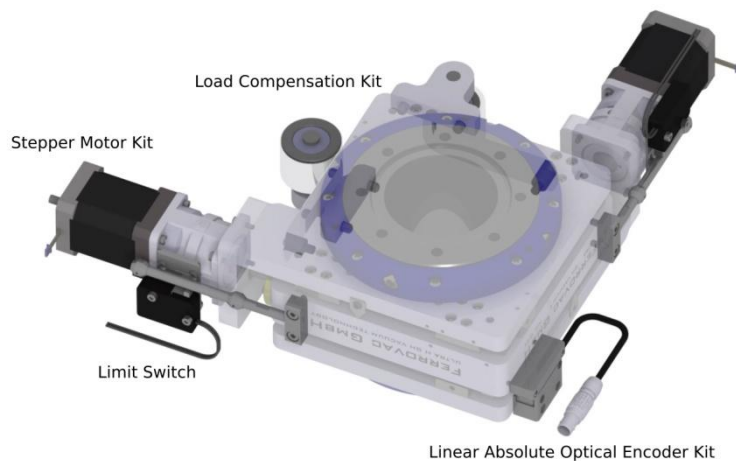
8 Options and Upgrades



Caution!

Always ensure visual contact before and during the operation of motorized components, to ensure that no collisions occur between components in or around the chamber/system.

Options and upgrades for the Boomerax XY Series are listed below. For details, visit our website www.ferrovac.com.



8.1 Stepper Motor Kit

Motorization kit for **one axis** of Boomerax-Series XYZ Manipulators. NEMA stepper motor with 1.8° step resolution. Operable at ambient temperature. Not bakeable (remove for bakeout)! For further technical specifications about the motor units, please contact us directly at sales@ferrovac.com.

XY Stage	Suitable Motor Kit	Max. Torque	Motor Datasheet
MXY40...	MOTN14T0.23-0006	0.23 Nm	ST3518L1204-B
MXY63...	MOTN17T0.7-0006	0.7 Nm	ST4118D3004-B
MXY100...	MOTN23T1.9-0006	1.9 Nm	ST5918L2008-B

8.2 Limit Switch Kit

One axis electrical limit switch for Boomerax XY Manipulators.

XY Stage	Recommended Limit Switch Kit
MXY40...	UPGRADEMXY40(+MXLIMELKIT)
MXY63...	UPGRADEMXY63(+MXLIMELKIT)
MXY100...	UPGRADEMXY100(+MXLIMELKIT)

8.2.1 Technical Data for Limit Switch Kit:

- normally closed
- max. voltage: 250 VAC, 24VDC
- max. continuous current: 10.1 A
- min. switching capacity: 12 VDC, 10mA
- temperature range: -40°C ~ 150°C (switch and wiring are bakeable)
- adjustable position
- incl. 2x Amphenol C091B plugs (**not bakeable**)

8.2.2 Limit Switch Adjustment



Caution!

Always ensure visual contact before and during the operation of motorized components, to ensure that no collisions occur between components in or around the chamber/system.

- Step 1. As the first step in adjusting the limit switches, retract the XY Stage to the lowest possible position X and/or Y position. Do not try to exceed this minimum value as it can cause the product to jam or get broke.
- Step 2. Adjust the limit position: loosen (**only untighten them, do not remove**) the fixing set screw of the flat point. After, move the flat point until you hear the switch click. Now set the flat point exactly at this position by tightening the set screw again.
- Step 3. Extend the actuator: Now that we have one limit set, go to the maximum position to the opposite extreme.
- Step 4. **Adjust the other flat point:** Repeat **Step 2** to set the limit switch at the other extreme position. This is the extended most extreme position.
- Step 5. Checking the Limit Switch: This is the final step of adjusting the limit switches of your Boomerax XY stage. In this step, you need to ensure whether the switches are set properly, and check whether there are any drifts in direction. To check this, run an application that moves from limit switch to limit switch. If it runs smoothly without any problem, then it means that the limit switches have been set correctly.

8.3 Load Compensation and Load Relief Upgrade

Constant force spring load relief for Boomerax XY Manipulators. Fully bakeable to 200 °C.

XY Stage	Recommended Limit Switch Kit	Spring Force
MX Y40...	UPGRADEMX Y40(+MX YFS22)	22 N
MX Y63...	UPGRADEMX Y63(+MX YFS47)	47 N
MX Y100...	UPGRADEMX Y100(+MX YFS74)	74 N

8.4 Linear Absolute Optical Encoder Kit for X-Translator

Absolute, optical linear encoder with 78nm resolution. Stainless steel scale. Not bakeable!

XY Stage	Recommended Limit Switch Kit	Linear range
MX Y40...	UPGRADEMX Y40(+MX ENCLAK25)	25 mm
MX Y63...	UPGRADEMX Y63(+MX ENCLAK25)	25 mm
MX Y100...	UPGRADEMX Y100(+MX ENCLAK50)	50 mm

8.5 Travel Flange Upgrade for MX Y Boomerax

We provide simple solutions to change the CF size of both travel- and base flange (please refer also to *4.2 Product Configuration List*). For details, visit our website www.ferrovac.com or contact us directly at sales@ferrovac.com.

9 Additional Information

9.1 Return of Defective Items

Ferrovac GmbH requires a completed declaration of contamination form and will issue an RMA (Return of Materials Authorization) form, before any items are factory returned. Please contact us beforehand. You will be given an RMA number and information on how to proceed with the return of defective items.

9.2 Downloads

The latest version of this manual can be downloaded from our website Ferrovac.com. For any suggestions or questions concerning this manual, please don't hesitate to contact us.

Ferrovac GmbH
Thurgauerstrasse 72
8050 Zürich
Phone: +41 (0) 44 273 16 38
E-Mail: sales@ferrovac.com
Website: www.ferrovac.com